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| CERTIFICATE OF TRANSMISSION BY FACSIMILE (37 CFR 1.8)<br>Applicant(s): Malcom James Grieve, et al. | | | Docket No.<br>DP-304989 |
|---|---|---|---|
| Application No.<br>09/996,622 | Filing Date<br>November 29, 2001 | Examiner<br>Langel, Wayne A. | Group Art Unit<br>1754 |

Invention: **REFORMER SYSTEM PROCESS**

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OCT 19 2004

| TRANSMITTAL OF APPEAL BRIEF (Large Entity) | Docket No. DP-304989 |
|---|---|

In Re Application Of: **Malcom James Grieve, et al.**

| Application No. | Filing Date | Examiner | Customer No. | Group Art Unit | Confirmation No. |
|---|---|---|---|---|---|
| 09/996,622 | November 29, 2001 | Langel, Wayne A. | | 1754 | 5304 |

Invention: **REFORMER SYSTEM PROCESS**

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DP-304989

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

| | | | |
|---|---|---|---|
| Appellants: | MALCOM JAMES GRIEVE, et al. | ) | |
| Serial No.: | 09/996,622 | ) | Group Art Unit: 1754 |
| Filed: | November 29, 2001 | ) | Examiner: Langel, Wayne A. |
| For: | REFORMER SYSTEM PROCESS | ) | |

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

**APPEAL BRIEF**

DP-304989

## I. REAL PARTY IN INTEREST

The real party in interest in this appeal is Delphi Technologies, Inc.

## II. RELATED APPEALS AND INTERFERENCES

There are no related appeals or interferences know to Appellants, Appellants' legal representatives, or assignee that will directly affect, be directly affected by, or have a bearing on the Board's decision in the pending appeal.

## III. STATUS OF THE CLAIMS

Claims 1-26 are pending in the application. Claims 1-18 stand finally rejected, and Claims 19-26 are allowed. Claims 1-18, as they currently stand, are set forth in Appendix A. Appellants hereby appeal the final rejection of Claims 1-18.

## IV. STATUS OF THE AMENDMENTS

No amendments have been filed subsequent to the final rejection dated April 20, 2004. All prior amendments have been entered.

## V. SUMMARY OF CLAIMED SUBJECT MATTER

Gasoline and diesel fuels are difficult to fully vaporize and contain compounds that readily form soot and other carbonaceous matter. (Page 4, paragraph [0010]). The catalysts used in the reformer systems are sensitive to sooting and contamination. (Page 4, paragraph [0010]). When sooting occurs, the active catalyst material can be fully or partially deactivated, thereby adversely affecting the efficiency and operating lifetimes of the reformer system. (Page 4, paragraph [0010]). Moreover, the soot, formed primarily from carbon, can react exothermically when exposed to an oxidant such as air. (Page 4, paragraph [0010]). A rapid increase in temperature may cause melting and destruction of the catalyst support as well as a loss of the precious metal material that makes up the catalyst material. (Page 4, paragraph [0010]).

The present application (e.g., Claim 1) is directed to a process for operating and removing contaminants from the reformer system. (Page 4, paragraph [0012]). For example, a process for operating a reformer system (10) comprises introducing a gas mixture to the reformer system (10); increasing a proportion of an oxidant in the gas mixture and controlling a flow rate

of the gas mixture; and reacting the gas mixture to form a reformate stream and to increase a temperature in the reformer system (10), wherein the temperature is effective to remove a contaminant from the reformer system (10). (Page 4, paragraph [0012]; and Figure 1).

More particularly, removal of contaminants (e.g., carbon, soot, and the like) from a reformer system can comprise maintaining a catalyst substrate within the system at a temperature greater than the normal operating temperatures for that particular reformer system (e.g., a catalyst substrate temperature less than or equal to about 150°C greater than normal operating temperature for the reformer system, wherein the normal operating temperature of the catalyst substrate is typically about 750°C to about 950°C for most reformer systems). (Page 6, paragraph [0021]). Maintaining the temperature greater than the normal operating temperature can be attained, for example, by controlling the fuel to air (f/a) equivalence ratio (See Claim 3) and the flow rate of the other oxidants used (e.g., air, water, carbon dioxide, and the like, or combinations comprising at least one of the foregoing oxidants) (See Claim 2). (Page 6, paragraph [0021]). This allows carbon (or other particulate) to be removed from the catalyst bed, particularly at the leading edge of the catalyst substrate. (Page 6, paragraph [0021]).

Furthermore, it is noted that by cycling the oxidant flow rate, e.g., from a first flow rate to a zero flow rate to a second flow rate back to a zero flow rate, and so on, remaining contaminants (e.g., carbon, and the like) in the reformer can be burned without adversely effecting the structural integrity of the reformer. (See Claim 18; and Page 8, paragraph [0025]). Moreover, oxidant can be introduced at an initial flow rate sufficiently below the peak oxidant flow rate to burn off contaminants in a controlled fashion, e.g., without an uncontrollable temperature spike that can adversely affect the catalyst. (Page 9, paragraph [0027]).

In short, the temperature and reaction control system advantageously prevents catalyst degradation caused by build-up of carbon and other particulate matter. (Page 22, paragraph [0062]). Moreover, the system prevents excessive temperature spikes when the carbon and other particulate matter are removed. (Page 22, paragraph [0062]).

## VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

Claims 1-18 stand rejected under 35 U.S.C. § 103(a), as allegedly unpatentable over U.S. Patent No. 6,214,066 to Nataraj et al.

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## VII. ARGUMENT

**Claims 1-18 are Non-Obvious over Nataraj et al.**

Claim 1 and 4-8

For an obviousness rejection to be proper, the Examiner must meet the burden of establishing a *prima facie* case of obviousness, i.e., that all elements of the invention are disclosed in the prior art; that the prior art relied upon, coupled with knowledge generally available in the art at the time of the invention, contain some suggestion or incentive that would have motivated the skilled artisan to modify a reference or combined references; and that the proposed modification of the prior art had a reasonable expectation of success, determined from the vantage point of the skilled artisan at the time the invention was made. *In re Fine*, 5 U.S.P.Q.2d 1596, 1598 (Fed. Cir. 1988); *In Re Wilson*, 165 U.S.P.Q. 494, 496 (C.C.P.A. 1970); *Amgen v. Chugai Pharmaceuticals Co.*, 927 U.S.P.Q.2d, 1016, 1023 (Fed. Cir. 1996).

In making the final rejection, the Examiner relied upon the reasons given in the prior office action. (Final Office Action (F.O.A.) dated April 20, 2004, page 2). In the "prior office action" (i.e., the Office Action (O.A.) dated November 13, 2003), the Examiner stated that "one of ordinary skill in the art would be motivated to avoid carbon deposition in the process of Nataraj et al., since it is well-known that carbon deposition poisons the catalyst." (O.A., page 3). Appellants agree with the Examiner that one of skill in the art would generally prefer to avoid carbon deposition, but respectfully disagree that this would have provided the necessary motivation to lead one of skill in the art to modify Nataraj et al. in such a manner as to obtain Appellants' independent Claim 1 with a reasonable expectation of success. More particularly, with regards to independent Claim 1, Nataraj et al. at least fail to teach or suggest a process for operating a reformer system comprising, *inter alia*, increasing a proportion of an oxidant in the gas mixture and controlling a flow rate of the gas mixture; and reacting the gas mixture to form a reformate stream and to increase a temperature in the reformer system, wherein the temperature is effective to remove a contaminant from the reformer system.

Nataraj et al. teach that

> synthesis gas is produced from a methane-containing reactant gas in a mixed conducting membrane reactor in which the reactor is operated to maintain the product gas outlet temperature above the reactant gas feed temperature wherein the total gas pressure on the oxidant side of the membrane is less than the total pressure on the reactant side of the membrane.

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(Abstract). Furthermore, Nataraj et al. teach that a number of chemical reactions can occur "among several chemical species present including oxygen, hydrogen, water, carbon monoxide, methane and possibly elemental carbon". (Col. 11, lines 1-4). More particularly, Nataraj et al. teach that the primary reactions are as follows (Col. 11, lines 5-25):

$$CH_4 + 1/2\ O_2 \rightleftharpoons 2\ H_2O + CO \quad (1)$$

$$CH_4 + 3/2\ O_2 \rightleftharpoons 2\ H_2O + CO \quad (2)$$

$$CH_4 + 2\ O_2 \rightleftharpoons 2\ H_2O + CO_2 \quad (3)$$

$$CH_4 + H_2O \rightleftharpoons 3\ H_2 + CO \quad (4)$$

$$CH_4 + CO_2 \rightleftharpoons 2\ H_2 + 2\ CO \quad (5)$$

$$CO + H_2O \rightleftharpoons H_2 + CO_2 \quad (6)$$

$$H_2 + CO \rightleftharpoons C + H_2O \quad (7)$$

$$2CO \rightleftharpoons C + CO_2 \quad (8)$$

$$C_nH_m \rightleftharpoons nC + m/2\ H_2 \quad (9)$$

In making the final rejection, the Examiner relied upon these equilibrium reactions in making the rejection, stating that "it would have been obvious from such reactions that carbon could be removed, as well as prevented from being formed by controlling the reaction temperature, composition, and constituents...." (F.O.A, page 2). It appears that the Examiner, based upon a series of equilibrium equations, leaped to a conclusion of obviousness with out providing motivation for the particular method claimed in the present application and without providing an expectation of success for that method.

Appellants respectfully submit that the test for obviousness is not what "could" be done by an artisan, but what "would" be done by an artisan with a reasonable expectation of success based on the entire teachings of Nataraj et al. More particularly, Nataraj et al. teach that "reactions (7), (8), and (9) form elemental carbon which is undesirable in reactor operation." (Col. 12, lines 44-45). Additionally, they teach that "the extent of carbon deposition by reaction (9) is controlled by the reactant feed temperature, compositions, and also by the gas pressure."

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(Col. 12, lines 57-59). In other words, reading this teaching in the context of the entire patent, as is required, it appears that Nataraj et al. are merely teaching reaction kinetics that favor making synthesis gas, while avoiding carbon deposition. Additionally, with regards to reaction kinetics Nataraj et al. teach, "if the local oxygen flux is too high, and the endothermic reactions [i.e., reactions (4) and (5)] cannot kinetically keep up with the exothermic reactions to proceed to an extent sufficient to keep the region from overheating." (Col. 11, lines 48-51). Absent is any teaching or suggestion of increasing a proportion of an oxidant in the gas mixture.

Nevertheless, in making the rejection the Examiner stated that since Nataraj et al. teach

> the presence of oxygen in the reactants and the reactant feed temperature affect the extent of carbon deposition. It would be obvious from such teachings that an increase in oxygen concentration in the reactants would cause and increase in temperature, due to the exothermic reaction between the oxygen and hydrocarbon. Accordingly it would not be unexpected that the steps recited in applicant's claim would result in the prevention (or removal) of carbon in the reformer system.

(F.O.A., pages 2-3).

Appellants respectfully disagree with the Examiner for at least the reasons set forth above. In short, Nataraj et al., at best, teach introducing a gas mixture to a reactor. One of skill in the art would not have been lead, with any reasonable expectation of success to employ the presently claimed method. Nataraj et al. teach that there are several reactions that occur and fail to teach how controlling each reaction constituent will affect the other reaction constituents and the other reactions at increasing a proportion of an oxidant in the gas mixture, since Nataraj et al. do not teach or suggest how the other constituents of the gas mixture should be controlled relative to "oxidants" in the gas mixture. Accordingly, Appellants' respectfully submit that the Examiner has not established a *prima facie* case of obviousness, since Nataraj et al. at least do not teach or suggest with any reasonable expectation of success increasing a portion of an oxidant in the gas mixture.

Additionally, it is noted that even if it is found that the Examiner has established a *prima facie* case of obviousness, which is not the case, Appellants teach a number of unexpected results (e.g., advantages) associated with their claimed invention. For example, Appellants teach that

> [T]he temperature and reaction control system prevents catalyst degradation caused by build-up of carbon and other particulate matter. Moreover, the system prevents excessive temperature spikes when the carbon and other particulate matter are removed.

(Specification, paragraph [0062]).

In other words, Appellants system allows carbon and other particulate matter to be removed from the reformer, while unexpectedly preventing excessive temperature spikes that can damage the reformer. For at least this reason and for the reason that Nataraj et al. at least fails to teach or suggest increasing the proportion of oxidant in the gas mixture, independent Claim 1 is not obvious over and is allowable over Nataraj et al. Moreover, as dependent claims from an allowable independent claim, Claims 2-18 are, by definition, also allowable. It is noted that at least dependent Claims 2, 3, and 18 comprise additionally patentably distinct features as discussed below.

Claim 2 and 9-17

Claims 2 and 9-17 are non-obvious and allowable over Nataraj et al. for at least those reasons set forth above with regards to independent Claim 1, since these claims depend from an allowable independent claim. Nevertheless, in addition to those reasons, Claim 2 comprises additional patentably distinct features.

For example, Nataraj et al. at least fail to teach or suggest controlling the flow rate of the gas mixture by monitoring a reformer system temperature; reducing the flow rate of the gas mixture when the temperature is greater than or equal to a first temperature; flowing the oxidant into the reformer system when the temperature is less than or equal to a second temperature; and reducing the flow rate of the oxidant when the temperature is greater than or equal to the first temperature.

Rather, as noted above, Nataraj et al. teach that "the extent of carbon deposition by reaction (9) is controlled by the reactant feed temperature, compositions, and also by the gas pressure." (Col. 12, lines 57-59). Absent from Nataraj et al. is, for example, the necessary suggestion of when the flow rate of the gas mixture should be reduced, or when the flow rate of the oxidant should be reduced. In contrast to Nataraj et al., Claim 2 specifically sets forth when these flow rates should be reduced. In short, Claim 2 sets forth a number of specific flow rate control criteria that are not taught or suggested by Nataraj et al. Accordingly, Claim 2 is not obvious over and is allowable over Nataraj et al. independent of finding independent Claim 1 allowable.

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Claim 3

Claim 3 is non-obvious and allowable over Nataraj et al. for at least those reasons set forth above with regards to independent Claim 1, since Claim 3 depends from an allowable independent claim. Nevertheless, in addition to those reasons, Claim 3 comprises additional patentably distinct features.

Nataraj et al. fail to teach or suggest a process for operating a reformer system comprising, *inter alia*, increasing a fuel to air equivalence ratio in the gas mixture and increasing the flow rate of the gas mixture to a peak flow rate. It is briefly noted for the convenience of the Board that Appellants definition of a fuel to air equivalence ratio, which can be found in their specification in [0023], is as follows:

The f/a equivalence ratio ($\phi$) is mathematically defined by Equation IV.

IV. $$\phi = \frac{\left(\frac{f_a}{a_a}\right)}{\left(\frac{f_s}{a_s}\right)}$$

where: $f_a$ = fuel actual
$a_a$ = air actual
$f_s$ = fuel stoichiometric
$a_s$ = air stoichiometric

Absent in Nataraj et al. is any teaching or suggestion that would lead one of skill in the art with a reasonable expectation of success, at deriving a f/a equivalence ratio, let alone teaching or suggesting increasing the f/a equivalence ratio. For at least this reason, dependent Claim 3 is non-obvious and allowable over Nataraj et al. independent of finding Claim 1 allowable.

Claim 18

Claim 18 is non-obvious and allowable over Nataraj et al. for at least the reasons set forth above with regards to independent Claim 1 and dependent Claim 2. Nevertheless, in addition to those reasons, Claim 18 comprises additional patentably distinct features.

Nataraj et al. fail to teach or suggest repeating flowing the oxidant into the reformer and reducing the flow of the oxidant to form a periodic pattern. Rather, Nataraj et al. is silent on the flow pattern of oxidant. Since Nataraj et al. fail to teach or suggest this element, the Examiner

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has not established a *prima facie* case of obviousness. Accordingly, Claim 18 is non-obvious and is allowable over Nataraj et al. independent of finding Claims 1 and 2 allowable.

## VIII. CONCLUSION

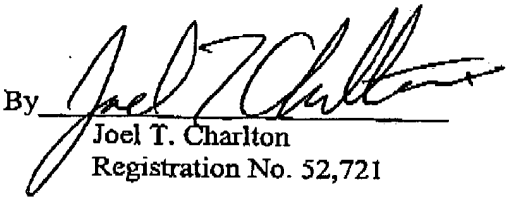
In summary, Claims 1-18 are non-obvious over the art of record. For the reasons cited above, Appellants respectfully submit that all of the claims are allowable and the application is in condition for allowance. Appellants respectfully request reversal of the outstanding rejections and allowance of this application.

In the event the Examiner has any queries regarding the submitted arguments, the undersigned respectfully requests the courtesy of a telephone conference to discuss any matters in need of attention.

If there are any additional charges with respect to this Appeal Brief, please charge them to Deposit Account No. 06-1130.

Respectfully submitted,

CANTOR COLBURN LLP

By 
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